Before the
Federal Communications Commission
Washington, D.C. 20554

In the matter of Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services	WT Docket No. 03-264

COMMENTS OF ERICSSON INC

To: The Commission

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December 19, 2005

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Summary.

Ericsson Inc ("Ericsson") applauds the recent efforts of the Federal Communications Commission ("Commission" or "FCC") to streamline and harmonize its wireless rules in light of technological advances, the competitive marketplace, and rural consumers' needs. The Commission should continue to build on its recent forward-looking decisions that encourage improvements in coverage, innovation, and cost-effective deployment of wireless services in rural areas by adopting CTIA's proposed revisions to its power limit rules. Broadly increasing base station power limits and applying these limits on a flexible basis (measured based on average power) will improve service in rural and urban areas, reduce deployment and operations costs, encourage innovation, and achieve many other benefits including technological neutrality.

For these reasons, Ericsson recommends that the FCC:

- Continue to encourage development of new and increasingly efficient technologies and facilitate wireless operators' entry into rural areas by adopting CTIA's proposal to increase radiated power limits measured using power spectral density per MHz;
- Ensure that its rules are technologically-neutral by allowing a choice between a new power spectral density per-MHz limit with increased radiated power or its current power limit per-carrier, as proposed by CTIA, thus ensuring flexible treatment of current and future narrowband systems and preventing negative impact;
- Provide industry the opportunity to develop efficient, cost-effective, innovative technologies by implementing its new power limits as a sliding scale, as proposed by CTIA;

- Provide regulatory certainty by clarifying that EIRP can be measured on an average basis, consistent with prior FCC direction, industry standards, and FCC requirements for out-of-band emissions;
- Refrain from setting Peak-to-Average Ratio (PAR) limits when adopting average limits, since industry already uses techniques to minimize PAR to help reduce equipment costs and achieve more efficient operations; and
- Permit measurement of handset EIRP based on average power as well, to ensure consistent measurement methods.

In these ways, the FCC will promote its policy goals of regulating existing and emerging technologies in a neutral manner and encouraging wireless service improvements, in particular, in rural areas. By adopting CTIA's proposal, the FCC will allow operators the flexibility to customize technology to best meet their customers' needs, and also ensure that its rules are forward-looking and will allow and encourage innovation and technological advancements.

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COMMENTS OF ERICSSON INC

I. Introduction.

Ericsson Inc ("Ericsson") hereby submits these comments in response to issues raised by the Federal Communications Commission ("FCC" or "Commission") in its *Further Notice of Proposed Rulemaking* ("*FNPRM*"), released August 9, 2005,[1] related to its Part 24 base station Equivalent Isotropically Radiated Power ("EIRP") limits. The Commission seeks comment on proposals to revise its radiated power rules for Personal Communications Services ("PCS"), Advanced Wireless Services ("AWS"), and other wireless services.

In particular, the FCC seeks comment on CTIA's proposal that the FCC make several revisions to its Part 24 rules, and that it mirror those changes in its Part 22 and Part 27 rules.[2] CTIA recommends that the FCC incorporate power spectral density as a means of EIRP measurement, increase EIRP limits for PCS stations that measure emissions on a power spectral

[1] *See Report and Order and Further Notice of Proposed Rulemaking, In the Matter of Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services*, 20 FCC Rcd. 13,900 (2005) (*"R&O" or "FNPRM*").
[2] *See id.* at ¶¶ 51-54.

density basis, and clarify that all EIRP limits be specified in terms of average, not peak, power.[3] The FCC also asks for comment on specific practical and technical aspects of the proposal, including whether increasing the EIRP limit may allow operators to use excessive power, or may result in harmful interference.

In its comments, Ericsson describes the benefits of higher EIRP limits, and explains that practical operational limitations, operator coordination practices, and existing emission regulations already protect comprehensively against excessive power use and harmful interference. Ericsson urges the Commission to refrain from implementing unnecessary regulation and, instead, adopt CTIA's sliding scale proposal so that wireless consumers may achieve the full benefits of operator flexibility. Increasing operator flexibility will enable operators to provide lower cost coverage to subscribers in any location of their service area, moving at any speed, by establishing more economical systems and fine tuning those systems to provide quality service in hard to reach areas, such as the lower reaches of buildings, parking garages, and other subterranean construction.

Also, Ericsson strongly supports CTIA's proposal that the FCC allow measurement of EIRP based on average power. Average measurement will provide more accurate and relevant output information for newer technologies which produce emissions where the modulation envelope is not of constant amplitude. The FCC has already interpreted its measurement rules to permit average measurements, and average measurements are consistent with current measurement procedures, industry standards, and OOBE measurement rules. The FCC need not

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[3] *See* CTIA Ex Parte Submission, *In the Matter of Biennial Regulatory Review - Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services*, WT Docket No. 03-264 (Feb. 7, 2005) ("CTIA Proposal") at 2. While CTIA proposes giving stations a choice between the two EIRP limits/measurement methods, the FCC's *FNPRM* proposes a two-tier limit that mandates a per-carrier limit for narrowband stations and a higher power spectral density per-MHz for wideband stations. *See FNPRM* at ¶ 51. Ericsson supports CTIA's proposal.

limit PAR if it permits average measurements, because manufacturers already have market incentives and employ a number of techniques to keep the ratio as low as possible. The FCC should also permit average measurements for handset EIRP, for the same reasons.

II. Ericsson Commends the Commission for Streamlining Its Power Rules.

Ericsson commends the Commission for its ongoing efforts to streamline and harmonize its administrative rules. The Commission's decisions to remove the transmitter output power limit and increase rural EIRP limits exemplify the Commission's ongoing efforts to update obsolete or ineffective rules in light of changes in technology and the competitive marketplace and specifically to address the rural market.[4] In its *Biennial Review Report and Order*, the Commission agreed with Ericsson and other commenters, finding that its base station transmitter output power limits were unnecessary and that removing the limits would harmonize service rules and provide increased flexibility.[5] Similarly, in its *Rural Order*, the Commission increased the radiated output power limits for PCS, AWS, and Cellular licensees in rural areas.[6] After carefully balancing interference concerns, the Commission found that this change would promote spectrum access and increase efficiency and flexibility in rural areas.[7]

The Commission should build on these decisions, continuing to focus on encouraging improvements in coverage, and specifically deployment of wireless services in rural areas. As the Commission has recognized in previous proceedings, broadly increasing power limits will improve service in rural and urban areas, encourage improved technology, reduce deployment and

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[4] *See Report and Order and Further Notice of Proposed Rulemaking, In the Matter of Facilitating Provision of Spectrum-Based Services to Rural Areas and Promoting Opportunities for Rural Telephone Companies To Provide Spectrum-Based Services*, WT Docket Nos. 02-381, 01-14, 03-202 (Sep. 27, 2004) ("*Rural Order*").
[5] *R&O* at ¶ 20.
[6] *See, e.g., Rural Order*.
[7] *See id.*

service cost, and achieve many other benefits. In particular, with increased power limits, rural operators will be able to capitalize on increased operating efficiencies to bring the benefits of wireless services more cost-effectively to consumers in remote and rural areas.

III. The FCC Should Adopt CTIA's Proposal to Provide the Benefits of Increased Radiated Power Limits to Operators.

In its *FNPRM*, the FCC requests comment on CTIA's proposed revisions to its Part 24 base station EIRP limits,[8] and poses specific questions about technical and practical issues arising from the proposal. CTIA's proposal contains three components. First, CTIA proposes that the FCC add a power spectral density feature to the current rule that would allow more radiated power, in amounts proportional to bandwidth, allowing operators to implement cost effective and efficient systems.[9] Under CTIA's proposal, the FCC would achieve neutrality for both narrowband and wideband systems by allowing use of either the new power spectral density measurement or its current radiated power limits, measured on a per-carrier basis, so that narrowband systems do not have to decrease power.[10] Second, CTIA proposes that the FCC increase the maximum EIRP limits for systems using power spectral density measurements for radiated power.[11] Third, CTIA proposes that the FCC measure its radiated power rule based on average power, or peak or average power, and not limit measurement to peak power.[12] Additionally, CTIA proposes that the FCC implement its new radiated power limits in a sliding scale.[13] The FCC questions whether it should adopt these changes and if it should mirror them in

[8] *See FNPRM* at ¶ 49.
[9] *See* CTIA Proposal at 2-4.
[10] *See id.*
[11] *See id.*
[12] *See id.*
[13] *See id.* at 5.

its Part 27 Advanced Wireless Service and Part 22 rules to ensure regulatory parity for technically-like services.[14]

As Ericsson has stated in comments and *ex partes* filed with the Commission, it strongly supports increasing EIRP limits, particularly for wideband systems, to ensure technological neutrality, encourage innovation, and promote deployment of wireless technologies.[15] CTIA's proposal, representing broad industry consensus, will best achieve these goals. Moreover, Ericsson's experience as a base station manufacturer and supplier to wireless carriers[16] suggests that existing technical and operational constraints and emissions restrictions already provide comprehensive safeguards against use of excessive power that can cause harmful interference.

A. Increasing Power Limits Will Benefit the Industry and Consumers.

Recognizing that technology has improved significantly since it initially adopted its 1640 Watt EIRP limit, the FCC asks whether it should increase its overall radiated power limits substantially over the limits contained in its current rules, and whether and to what extent licensees will benefit from such an increase.[17] Ericsson recognizes that the Commission has

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[14] *See FNPRM* at ¶ 51.

[15] *See, e.g.,* Comments of Ericsson Inc, WT Docket No. 03-264 (Apr. 23, 2004); Reply Comments of Ericsson Inc, WT Docket No. 03-264 (May 24, 2004); Ex Parte Memorandum regarding Facilitation of Widespread Deployment of and Access to Wireless Services, WT Docket Nos. 02-381, 01-14, 03-264 (Jun. 29, 2004); Notice of Ex Parte Presentation Regarding Facilitation of Widespread Deployment and Access to Wireless Services, WT Docket Nos. 03-264, 04-180 (Sep. 9, 2004); Ex Parte Memorandum regarding Facilitation of Widespread Deployment of and Access to Wireless Services, WT Docket Nos. 03-264, 04-180 (Sep. 16, 2004).

[16] Ericsson is the largest supplier of mobile systems in the world and has a presence in more than 140 countries. It supports all major standards for wireless communication. The world's ten largest mobile operators are among Ericsson's customers and approximately 40 percent of all mobile calls are made through Ericsson's systems. *See* http://www.ericsson.com/about/.

[17] *See FNPRM* at ¶¶ 64-67. In fact, it is estimated that a reasonable reflection of the technological improvements since the FCC adopted the 1640 Watt EIRP limit is approximately 6 dB, or four times the present limit. *See* Comments of Ericsson Inc, *In the Matter of Biennial Regulatory Review – Amendment of Parts 1, 17, 20, 21, 22, 24, 27, 73, 74, 80, 90, 95, and 101 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services,* WT Docket No. 04-180 (Jul. 12, 2004).

already increased its power limits for rural areas and commends its decision to further advance this progress.

In this and other proceedings, commenters have consistently recognized that increasing power limits will improve service in both rural and urban areas and encourage development of improved technology, among other benefits.[18] EIRP limits dictate how operators may construct their systems. Under the constraints of these limits, operators must install a certain number of transmitter sites to cover a particular area with an acceptable signal to noise ratio and must fine tune their networks to provide the best possible coverage. Increasing EIRP limits will provide operators with additional flexibility by allowing them to be more selective in their site locations and install fewer transmitters where use of higher power is feasible, lowering the cost of deploying a network or increasing coverage, and permitting them to improve coverage in areas where installing additional transmitters is impossible or impractical. Specifically, increased power limits will allow rural operators to expand the reach of existing systems without adding infrastructure and will reduce the number of transmitting facilities required to provide service.[19] In urban areas, higher EIRP limits will improve the indoor coverage, grade, and quality of service. Higher limits will also promote use of new technologies, such as higher gain antennas, and will encourage improvements in the design of subscriber products.

In its *FNPRM*, the Commission asks commenters to provide specific examples of operators' routine or extraordinary needs for high levels of power.[20] Operators currently have a number of needs for higher power. For example, increasing EIRP limits will allow wireless

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[18] *See., e.g.,* Comments of Ericsson Inc, WT Docket No. 03-264 (Apr. 23, 2004)("Ericsson Comments") at 3; Comments of Motorola, Inc., WT Docket No. 03-264 (Apr. 23, 2004)("Motorola Comments") at 4; Comments of Qualcomm Incorporated, WT Docket No. 03-264 (Apr. 23, 2004)("Qualcomm Comments") at 2, 8; Comments of Powerwave Technologies, Inc., WT Docket No. 03-264 (Apr. 23, 2004)("Powerwave Comments") at 6; and Comments of Cingular Wireless LLC, WT Docket No. 03-264 (Apr. 23, 2004)("Cingular Comments") at 3-4.

[19] *See* Powerwave Comments at 6; Qualcomm Comments at 8; Motorola Comments at 4.

[20] *See FNPRM* at ¶ 65.

service to penetrate further into the lower and inner reaches of buildings, parking garages, public transportation systems, and other subterranean or dense construction. Increasing EIRP limits will allow operators to increase the capacity of their systems, resulting in fewer dropped or failed calls in urban areas and a lower likelihood of system failure in the event of emergencies. In rural areas, higher EIRP limits will permit wireless networks to cover broader areas at a lower cost, expanding the availability of wireless services into remote, sparsely populated areas in which such service was economically and technically infeasible with lower EIRP limits.

Ericsson recognizes that, currently, available technologies may not be able to fully utilize the higher limits requested under all circumstances because of practical considerations such as operator coordination, system operational characteristics, and emissions limits. Increasing the limits to the requested levels, though, will encourage development of new technologies that may provide improved coverage efficiently without causing harmful interference to adjacent spectrum users.

Based on the current and prospective needs of wireless system operators, it is clear that increasing power levels will substantially benefit both the industry and consumers by improving technology neutrality, encouraging innovation, and facilitating and promoting deployment of more efficient and effective wireless technologies. Commenters have consistently recognized that increasing power limits will improve service in both rural and urban areas and encourage development of improved technology, among other benefits. Therefore, the FCC should adopt CTIA's proposal, allowing all technologies, whether narrowband or wideband, to use either the Commission's current radiated power limits, measured on a per-carrier basis, or to increase their radiated power under new power spectral density per MHz measurements.

B. Increasing EIRP Limits Will Not Lead to Excessive Radiated Power Causing Harmful Interference.

In its *FNPRM*, the FCC asks for comment on whether increasing power limits will permit excessive radiated power and cause harmful interference.[21] Current industry practices, system operational characteristics, and existing emissions rules already constrain operators from using excessive power or causing harmful interference.

While the FCC is correct that some technologies, operating at the proposed 6560 Watt rural limit in a 5 MHz bandwidth, could theoretically reach radiated power levels of as much as 32,800 Watts,[22] such a high level of operation is not feasible in practice. For example, in order to operate at an aggregated radiated power level of 32,800 Watts, a GSM system would have to use ten carriers in its bandwidth. Operationally, however, it is impossible to use such a high number of carriers in a contiguous 5 MHz bandwidth. Typically, two GSM carriers operate in a 5 MHz band under normal circumstances, and a maximum of three under optimal circumstances. In wider bandwidths, while aggregated power is high, the radiated power per-MHz is essentially identical to that when a single carrier occupies the band.

Moreover, the highest EIRP limits will be permitted in rural, not urban, areas where practical market constraints limit a system's number of carriers even further. In rural system operation, service is provided to fewer customers and signals must travel greater distances. Thus, most rural systems use only a single carrier to provide service to the small number of customers in the area. Although, theoretically, a rural operator could use additional carriers on its system, adding capacity to a rural network where none is needed would be inefficient and a needless

[21] *See id.* at ¶ 60.
[22] *See id.*

expenditure. Rural carriers have no practical incentive to add carriers when their customers' needs do not demand it.

Additionally, existing protections for adjacent spectrum users practically limit systems' radiated power. The FCC's current rules regulate interference and emissions, and it is unnecessary for the FCC to perform the same task through a limit on radiated power. For example, the FCC already has rules in place that control interference where operators use different frequency blocks within the same geographic area[23] and where operators use the same frequency blocks in different geographic markets.[24] These and other rules effectively protect against harmful interference that could be caused by a system's operation at any power level.

Additional rules or more stringent power limits intended to mitigate interference will complicate development and deployment of new technologies in the future with no benefit to licensees. As the market continues to develop and expand, these rules will inevitably undergo repeated revisions. The FCC should refrain from implementing unnecessary regulations and should instead rely on the combination of market forces, technology, and its emissions regulations to continue to protect against harmful interference. A "light touch" regulatory scheme will allow operators flexibility to implement efficient, cost effective, and innovative wireless systems and encourage development of new technologies without requiring additional revisions to these rules in the near future.

If the FCC has any remaining interference concerns, it could establish information disclosure or sharing guidelines for licensees.[25] For example, the FCC could provide coordination guidelines similar to its MDS relocation rules that would be triggered by the distance between

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[23] *See* 47 C.F.R. § 24.238.
[24] *See id.* at § 24.236.
[25] *See FNPRM* at ¶ 66.

base stations and could encourage licensees to follow the technical information exchange protocol established by the National Spectrum Managers Association. Such guidelines should not be mandated, however, but would be a helpful resource that the industry could implement voluntarily, if necessary.

C. The FCC Should Adopt a Power Spectral Density Per-MHz Measurement and also Retain a Per-Carrier Measurement to Ensure Technological Neutrality.

As the FCC recognizes, its current rule applies the same radiated power limit to both narrowband and broadband systems, and, as a result, only allows broadband systems to use about one-fifth of the radiated power per voice conversation that a conversation transmitted over a narrowband system may use.[26] Such a limit goes against the FCC's stated intent that its EIRP rule "neither penalize nor give advantage to any particular technology . . ."[27]

By adopting CTIA's proposal, allowing either per-carrier or power spectral density per-MHz limits, the FCC will place broadband and narrowband systems on even footing. For example, as explained by CTIA, its proposal will permit a broadband system operating at 3280 watts in a 5 MHz bandwidth to use the same basic total aggregate radiated power as a narrowband system operating one carrier in each MHz of the same bandwidth, as shown below.[28]

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[26] "Existing narrow emission PCS technologies, (*i.e.*, TDMA, GSM) carry 3 to 8 voice conversations per emission, while existing wide emission technologies (*i.e.*, CDMA) carry as many as 20 to 40 voice conversations per emission. Because the current rule makes no distinction between wide and narrow emissions, it applies the same maximum radiated power limit to both. Consequently, a wide emission system is allowed to provide only about one fifth of the radiated power for each voice conversation that a narrow emission system is allowed to provide, assuming each system is fully loaded and operating at the maximum power permitted by rule. Thus, the average voice conversation on the wide emission system would have a lower signal to noise ratio, which, despite the partially compensating processing gain provided by signal spreading, would reduce the coverage range." *Id.* at ¶ 58.

[27] *Id.* at ¶ 56.

[28] *See* CTIA Proposal at 3.

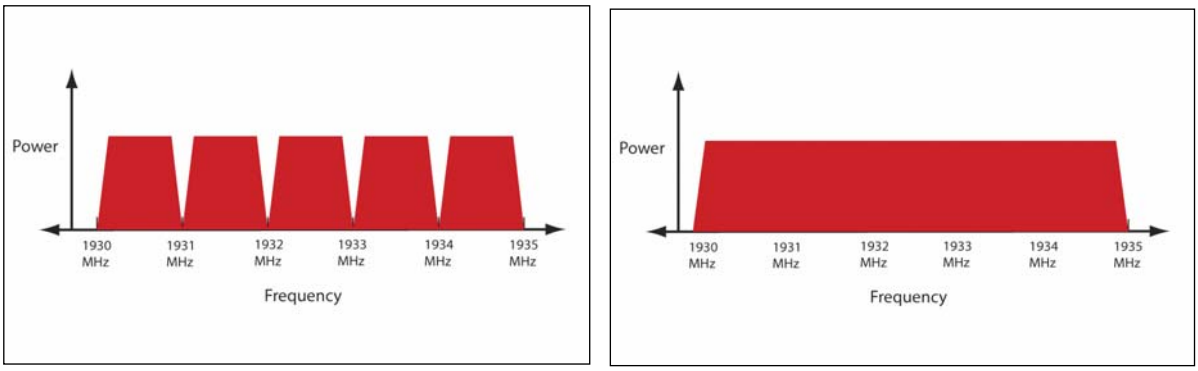

Figure 1

However, the FCC should not mandate that both narrowband and wideband systems comply equally with a power spectral density radiated power limit because of differences in the technologies.[29] As evidenced by CTIA's proposal and previous comments filed in this proceeding, the industry generally agrees that modifying narrowband emissions limits strictly based on a power spectral density model and implementing varying limits for different narrow bandwidths could adversely impact these systems and will result in the reverse effect of the current rule. While a power spectral density measurement works well for broadband technologies, mandating such a measurement uniformly across both narrowband and broadband technologies will impose overly strict limits on narrowband technologies, which can only use a limited number of carriers in their bandwidth.[30]

In particular, requiring narrowband emissions systems, such as GSM, to utilize a power spectral density per-MHz measurement under all circumstances, would in many cases decrease their signal-to-noise ratio for voice conversations carried over these systems, as compared to broadband systems, reducing narrowband systems' coverage range. Current operational and

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[29] *See id.* at ¶¶ 59-60.

[30] *See* Ericsson Ex Parte Memorandum Regarding Facilitation of Widespread Deployment of and Access to Wireless Services, *In the Matter of Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services,* WT Docket No. 03-264 (Sep. 16, 2004) at 2.

practical constraints limit narrowband systems to at most three carriers in a 5 MHz bandwidth, allowing narrowband systems that operate under CTIA's proposed increased power spectral density per-MHz limit to increase the amount of radiated power they may use and permitting both narrowband and broadband systems to use equal levels of radiated power, as depicted by Figure 1, above.[31] Thus, a power spectral density measurement would appear appropriate for both narrowband and wideband systems.

However, looking forward, mandating this measurement across all technologies will cause the reverse effect of the current rule, adversely impacting narrowband systems that are currently technically capable of operating multiple carriers in 1 MHz. For example, GSM requires a 12-frequency reuse distance which would effectively limit the number of carriers in a 5 MHz band to 24.[32] Requiring a GSM system that can operate multiple carriers in a single MHz to comply with the same power spectral density per-MHz limit applied to broadband systems would force these carriers to operate at a fraction of the power permitted for broadband.

The fact that current practical and operational limitations prevent multiple GSM carriers from operating in a single MHz band does not justify implementation of a limit that will prevent future innovation. Such a rule would force GSM carriers to deploy additional infrastructure to maintain the same coverage area, putting them at a clear competitive disadvantage to broadband systems. On the other hand, CTIA's proposal, which allows use of either a lower per-carrier limit or an increased per-MHz limit, is forward-looking to encourage innovation, efficiency, and increased utilization of existing technological capabilities.

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[31] In fact, CTIA's proposal would permit narrowband carriers to use higher power levels in some instances, given practical constraints that allow a maximum of three carriers per 5 MHz bandwidth. Under a power spectral density per-MHz limit of 3280 Watts per MHz, carriers would be limited to either 5466.67 Watts each (3280 Watts x 5 MHz / 3 carriers) or 3280 Watts each (3280 Watts per occupied MHz), depending on the specific interpretation of the rule.

[32] *See, e.g.*, Ericsson Inc Ex Parte Memorandum Regarding Facilitation of Widespread Deployment of and Access to Wireless Services, WT Docket Nos. 03-264, 04-180 (Sep. 16, 2004) at 2-3.

The FCC suggests implementing a two-tiered approach, establishing a dividing point between narrowband and wideband emissions.[33] However, adopting CTIA's proposal does not require establishing such a dividing point. Rather, CTIA's proposal allows use of either of the measurement approaches that best suits the needs of the individual networks, providing much needed flexibility for operators and encouraging increased efficiency and innovation.

D. The FCC Should Express Its New Power Limits as a Sliding Scale

The FCC asks whether, if it allows a higher radiated power, it should express the power in terms of a sliding scale, a specific limit, or a series of limits for various defined emissions bandwidths.[34] The FCC questions whether the sliding scale proposed by CTIA is the best structure for its power limits, noting that such a scale has "a potentially infinite number of linear scaled limit values."[35] Leaving a power limit scale open-ended, allowing systems to operate at infinitely high EIRP levels, the FCC notes, may not be an optimal approach.[36]

Ericsson supports CTIA's proposed sliding scale which will provide flexibility for development of new technologies. Such a scale will not require modifications as "broader band" technologies emerge, and will encourage innovation. Moreover, while a sliding scale will theoretically allow higher EIRP levels, many operational and technical factors provide a practical cap to these levels, as discussed in more detail above.[37] Thus, Ericsson believes that a sliding power limit scale will provide an optimal range of flexibility in which existing technologies may operate and new technologies emerge.

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[33] *See FNPRM* at ¶ 61.
[34] *See id.* at ¶¶ 62-63.
[35] *Id.* at ¶ 62.
[36] *See id.*
[37] Among other factors, interference issues are managed by regulatory factors (*e.g.,* out-of-band emissions ("OOBE") limits, coordination requirements, and other regulations) and operational factors (*e.g.,* cost, frequency reuse capability, equipment limitations, and geographical constraints).

Second, the FCC suggests that it could express its new power limits in terms of specific limits for particular bandwidth ranges; a "stepped" framework for power limits.[38] Ericsson submits that, while a specific "stepped" framework may serve the industry's current needs, it will not provide flexibility to allow for future technological developments. For example, upon development of new technologies that operate on broader bandwidths, the industry may discover in the future that "broader band" technologies are at a disadvantage compared with preexisting technology, as has happened with the current rule.

Third, the FCC proposes a series of power limits that assign an appropriate power limit for the technologies most commonly deployed in a particular emission bandwidth.[39] This rule structure, also overly limiting, will discourage innovation and introduction of new technologies. It will likely require new "entries" in the series for each new technology, forcing needless delays in introduction of new technologies and creating additional regulatory uncertainty.

IV. The FCC Should Specify Radiated Power Limits on the Basis of Average, not Peak, Power.

A. Overview.

The FCC also seeks comment on CTIA's proposal that it express radiated power limits for PCS and AWS stations on the basis of average, rather than peak, radiated power.[40] CTIA expresses concern that the Commission's current use of peak radiated power is "subject to interpretation" and can "lead to confusion."[41] Consequently, the Commission asks for comment on whether it should change its practice to specify an average radiated power measurement, as

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[38] *See id.* at ¶ 62.
[39] *See id.* at ¶ 63.
[40] *NPRM* at ¶¶ 68-70. CTIA proposed that the FCC express radiated power limits on the basis of "average," or "peak or average." *See* CTIA Proposal at 5-6. Ericsson supports CTIA's proposal.
[41] *Id.* at ¶ 70.

CTIA proposes.[42] It asks commenters to consider the pros and cons of peak and average radiated power limits in terms of controlling the interference potential of stations, conforming to current industry measurement procedures, using available measuring instruments, minimizing compliance burdens, and having applicability to the wide range of technologies in use today and in the future.[43] It also asks whether it should include a limit on Peak-to-Average Ratio (PAR), to guard against interference, if it measures its radiated power limit by average power.[44]

Ericsson strongly encourages the Commission to adopt CTIA's proposal. By adopting average power as its measurement basis, the Commission will ensure that the radiated power limits specified in its administrative rules are technology neutral, consistent with prior official direction and industry standards, as well as harmonized with its measurement method for OOBE. Furthermore, the FCC need not establish a maximum PAR to protect against harmful interference. Manufacturers and operators already use a number of techniques to minimize PAR, because a lower PAR helps decrease the cost of equipment, assure a higher quality signal, and increase efficiency of operations. Consequently, market forces provide comprehensive incentives to decrease base station PAR, and imposing additional regulation is not necessary. The FCC should use average measurements for handset EIRP, for all the same reasons.

B. The FCC Should Measure Radiated Power Limits on the Basis of Average Power to Ensure that its Limits are Technology-Neutral.

The FCC should clarify that industry may use average measurements for base station radiated power limits to ensure that its rule applies neutrally to a wide range of technologies in use today and in the future. As the FCC notes in its *FNPRM*, for most of the last fifty years, wireless

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[42] *See id.*
[43] See i*d.*
[44] See i*d.*

technologies have used frequency or phase modulation (FM or PM) to transmit analog voice and/or tone modulation.[45] The emissions from these technologies had a "constant envelope" in which the peak power of emissions was equal to their average power, since there were no peaks or valleys in the envelope of the modulated waveform.

Some newer technologies, such as W-CDMA and CDMA 2000, produce an emission where the modulation envelope is not of constant amplitude, however. In these cases, an average measurement provides more accurate and relevant information on output and a more accurate picture of power in the band. The peak measurement method only captures and represents power peaks that occur with low probability and for an extremely brief duration (sub-micro seconds). Thus, peak measurement artificially assigns a much higher power measurement in the band than levels typically observed during operation for these technologies.

Applying express "peak" language in the rule for non-constant envelope technologies like CDMA or W-CDMA would severely disadvantage these technologies. To comply with peak-measured limits, operators would have to decrease base station average output power, reducing the coverage and capacity of their networks significantly. CDMA and W-CDMA network operators would have to add new sites at additional expense to provide the same level of coverage and capacity that these technologies offer to the public today.

By clarifying in its rules that industry may use average measurements to determine base station radiated power limits, the Commission will apply its regulation in a technologically-neutral manner. With an average limit, the rule will apply fairly to all technologies in a manner that provides a more accurate picture of power in the band. An average power based rule will also apply neutrally to wireless operators, not placing operators that choose network technologies like

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[45] *See id.* at ¶ 68.

CDMA or W-CDMA at a competitive disadvantage. Overall, using an average measurement basis will make the rule independent of the underlying radio access technology used.

C. The FCC Should Adopt Average Radiated Power Limits to Ensure Consistency with Current Industry Measurement Procedures and Provide Regulatory Certainty.

The FCC should also ensure that its expressed radiated power limits are consistent with current industry measurement procedures, prior interpretations of its rules, and industry standards by clarifying that industry may use average measurements, as well as harmonize its power limit measurement procedures with its OOBE measurement procedures.

While the FCC's current PCS power limit specifies at subsection (a) that EIRP levels be measured on a peak basis, at subsection (d), the rule requires that peak transmit power be measured using instrumentation calibrated in terms of Root-Mean-Square-voltage.[46] Many in the industry already interpret the rule to allow average measurements, not only because of the rule's instrument calibration specification, but also for a number of other significant reasons.

First, the FCC has already interpreted its base station EIRP rule in practice to permit average power limit measurements. For example, on March 10, 2004, the FCC confirmed in an email to the Swedish TCB that it allows average measurements to be "more fair" when measuring CDMA and broadband signals:

> The "relaxation" for noise-like signal measurements is the allowance to use an Average detector instead of Peak or RMS detectors. Since the rules specify the peak power is the RMS equivalent power, we could force the use of only a RMS or Peak detector for measurements. But instead, we allow an Average detector to be more fair when measuring CDMA and broadband signals, which would yield a lower power reading as compared to RMS or Peak detectors. This means that 100 watts measured with an

[46] See 47 C.F.R. § 24.232(d).

> Average detector for a CDMA signal may be 1000 watts peak power, but we would allow this to be approved.

FCC staff also noted to Ericsson and the Swedish TCB that the Commission allows average detection as an alternative to peak measurements for measuring both transmitting carrier and out-of-band emissions. Based on the FCC's clarification, many in the industry have correctly interpreted the rule to allow average measurement methods. By officially adopting that interpretation here, the FCC will provide industry with "regulatory certainty" that it is in compliance with FCC regulations.

Moreover, industry standards widely use average, instead of peak, EIRP emissions measurements. For example, specifications covering equipment that coexists in CMRS bands incorporate power limits based on average power:

> For WCDMA/UTRA (TS 25.104)
> 6.2.1 Base station maximum output power
> Maximum output power, Pmax, of the base station is the mean power level per carrier measured at the antenna connector in specified reference condition.
>
> For CDMA (C.S0010-C)
> 4.3.1 Total Power
> 4.3.1.1 Definition
> Base station total power is the mean power delivered to a load with resistance equal to the nominal load impedance of the transmitter.[47]

By specifying an average measurement in its rule, the FCC may ensure its rules are consistent with technical standards set by expert industry standards bodies.

Further, applying an average method here will harmonize procedures for measuring base station power limits and out-of-band emissions limits. The FCC permits measurements of OOBE on an average, not peak, basis. For example, in an FCC Lab email directive, dated November 13,

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[47] 3rd Generation Partnership Project (3GPP), Technical Specification Group (TSG) RAN WG4, UTRA (BS) FDD; Radio Transmission and Reception, TS 25.104, available at http://www.3gpp.org/ftp/Specs/html-info/25104.htm.

2003 to Cingular Wireless, the FCC explained that average measurements could be used, particularly as applied to GSM and EDGE technologies. It stated:

> The average detector is an allowable alternative to measuring the carrier, but you also must use it for measuring the out-of-band emissions as well.

Notably, the FCC highlighted the importance of consistent measurement methods for both carrier power and out-of-band emissions.[48] If an average measurement can be taken for out-of-band emissions, then base station radiated power should be measured on the same basis for appropriate consistency.

D. Industry Practices Make Setting a PAR Limit Unnecessary to Control Base Station Interference.

The FCC asks whether it should implement a PAR limit if it adopts average radiated power measurements to guard against possible interference.[49] Setting a PAR limit through regulation is unnecessary and needlessly burdensome. Industry already uses a number of techniques to minimize PAR in practice to help reduce equipment costs and achieve more efficient operations. Additionally, non-constant envelope technologies with a PAR greater than zero already coexist without any significant interference problems.

PAR is directly correlated to equipment and deployment costs, and is thus kept to a minimum in practice. The PAR of a signal determines the required backoff[50] from the Power Amplifier (PA) compression point to keep clipping, and hence spectral regrowth, within

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[48] The FCC's emissions rules for Miscellaneous Wireless Communications Services clearly state that measurements of out-of-band emissions may be expressed in either peak or average values, as long as they are expressed in the same parameters as the transmitter power. *See* 47 C.F.R. § 27.53(a)(7). The FCC's emissions rules for Public Mobile Services and PCS do not provide measurement methods.

[49] *See FNPRM* at ¶ 70.

[50] The term backoff, as used in this filing, describes the practical operating point that permits linear distortion-free transmission. Typically, additional backoff is also required to ensure that the transistor is not driven into saturation, where it becomes very non-linear and creates substantial spectral regrowth. This incurs a further loss of efficiency.

acceptable limits, enabling base stations to transmit the maximum required power with the least backoff. A high PAR puts stringent requirements on the PA and reduces efficiency by requiring a higher input backoff to ensure that signal peaks are not significantly distorted due to PA non-linearity. Signals with a high PAR require more power consumption, and therefore increase cost. As a result, industry already has commercial incentives to lower PAR to help decrease equipment cost. In fact, market forces drive wireless telecommunications equipment manufacturers to select modulations with minimal PAR and incorporate peak reduction techniques to minimize overall equipment complexity and power consumption, as well as to lower costs.

Peak reduction schemes are designed to improve PA efficiency and facilitate the deployment of Digital/Analog converters. Many commercial products that can be integrated with a vendor's equipment are available to implement clipping. Manufacturers expend significant effort and research to find efficient algorithms that reduce peaks while maintaining modulation quality of base stations used in CDMA and other non-constant envelope technologies.

Manufacturers incorporate peak reduction schemes to ensure equipment meets proper certification standards as well as to address concerns of equipment cost and efficiency. For example, 3GPP Working Group 4, responsible for Radio Access Network issues, constructed a combination of W-CDMA parameters that produced a "worst case" wave form (one with the highest PAR value). The test model shown in Figure 2 depicts the modulation quality of a W-CDMA base station. The blue "no clipping" line on the graph that extends to 13 dB shows the unclipped wave form, representing the "worst case" PAR. The green line, which extends only to 8 dB, demonstrates application of a typical peak reduction scheme. This shows that, for W-CDMA, 13 dB is a "worst case" ratio from which PAR can be significantly reduced while maintaining the required modulation quality; the probability that a chip with a PAR over 8 dB with duration of

1/chip-rate will occur is 10^{-4} or lower. Similar algorithms can be applied for any CDMA- or OFDM-based systems to ensure that high PAR efficiency, and consequently lower costs, can be achieved.

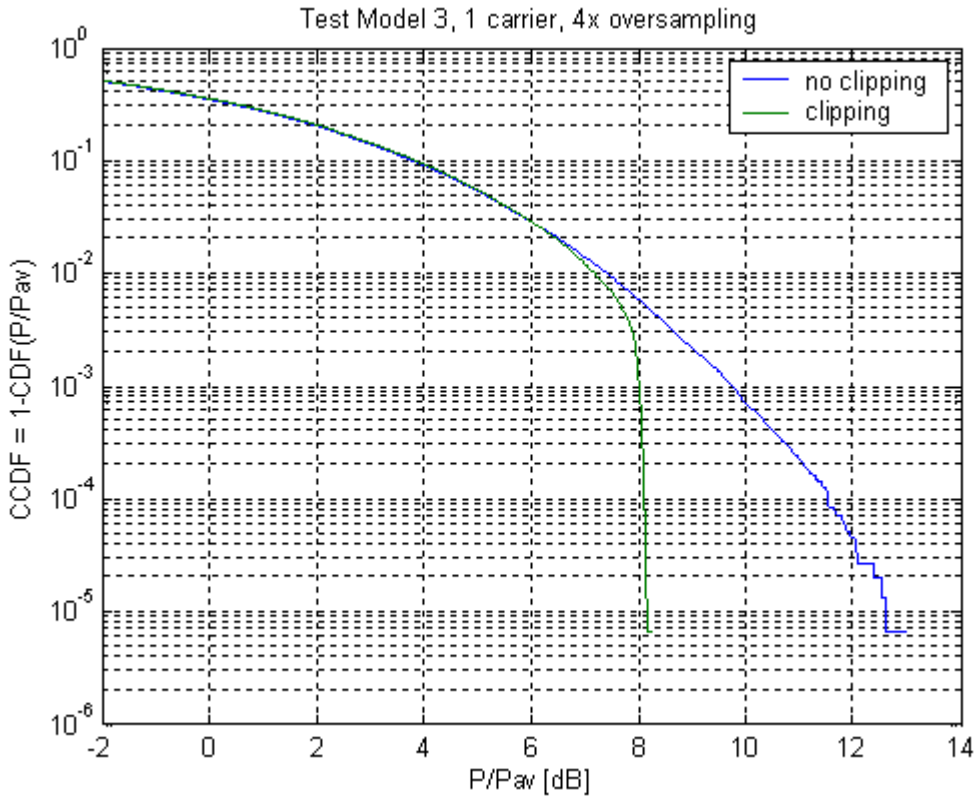

FIGURE 2

While waveforms with envelope peaks and valleys are deployed and operational today, and these systems use an average means of measurement, no evidence of additional harmful interference has been produced.

E. The Commission should also Allow Average Measurements for Mobile/Portable Station Radiated Power Limits to Ensure Flexibility and Consistent Application of its Rules.

While the Commission considers permitting average measurements for base station radiated power, it should also review whether it should apply average measurements to

mobile/portable station (handset or terminal) EIRP. Changes should be made to the handset section of the power limit rules for the same reasons as the base station rules.

The Commission's PCS rules require industry to measure handset EIRP based on peak power measurements in the same manner as its base station ERIP rules. Section 232(b) of Part 24 states:

> Mobile/portable stations are limited to 2 watts e.i.r.p. *peak* power and the equipment must employ means to limit the power to the minimum necessary for successful communications. [51]

Handsets using newer technologies, such as W-CDMA and CDMA 2000, produce emissions where the modulation envelope is not of constant amplitude and has a PAR greater than 0 dB. Measuring handset EIRP based on peak power does not present a fair or accurate picture of power in the band for these non-constant envelope technologies, placing them at an unfair competitive disadvantage. Therefore, the FCC should permit average measurements of handset EIRP to ensure that its rules are technologically neutral and measure EIRP fairly for all technologies.

Permitting average measurements of handset EIRP will not lead to use of excessive power, causing harmful interference. Industry deploys handsets widely using non-constant envelope technologies today and, consistent with industry standards, measures EIRP limits based on average power, without any evidence of harmful interference. In practice, industry already minimizes handsets' PAR as much as possible. Market forces drive wireless telecommunications equipment manufacturers to select modulations with minimal PAR and incorporate peak reduction techniques to minimize overall equipment complexity and power consumption for mobile units, just as for base stations.

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[51] 47 C.F.R. § 24.232(b) (emphasis added). At 47 C.F.R. § 27.50, the Commission's rules also prescribe peak EIRP limits for mobile and radiolocation mobile station transmissions.

For these reasons, the Commission should revise its rules to permit average measurements for handsets' EIRP, at the same time as it considers average measurements for base station EIRP, to ensure consistency and harmonization. Permitting average handset EIRP measurements will ensure technological neutrality, encourage innovation, and promote deployment of wireless technologies.

V. Conclusion.

The Commission should adopt CTIA's proposed revisions to its Part 24 base station EIRP rule, and should mirror these revisions in its Part 22 and Part 27 AWS rules. Certainly, higher EIRP limits will promote use of new technologies and improved product design, reduce service cost, and give operators greater flexibility to determine system architecture. Practical and operational constraints, as well as the Commission's current emissions rules, already serve as comprehensive limitations on excessive EIRP and harmful interference. Also, allowing radiated power to be measured on an average basis will provide a more accurate picture of power in the band for all technologies and assure consistency with industry standards, prior FCC directives, and current measurement procedures.

For these reasons, the Commission should:

- Continue to encourage development of new and increasingly efficient technologies and facilitate wireless operators' entry into rural areas by adopting CTIA's proposal to increase radiated power limits measured using power spectral density per MHz;
- Ensure that its rules are technologically-neutral by allowing a choice between a new power spectral density per-MHz limit with increased radiated power or its current power limit per-carrier, as proposed by CTIA, thus ensuring flexible treatment of current and future narrowband systems and preventing negative impact;

- Provide industry the opportunity to develop efficient, cost-effective, innovative technologies by implementing its new power limits as a sliding scale, as proposed by CTIA;
- Provide regulatory certainty by clarifying that EIRP can be measured on an average basis, consistent with prior FCC direction, industry standards, and FCC requirements for out-of-band emissions;
- Refrain from setting Peak-to-Average Ratio (PAR) limits when adopting average limits, since industry already uses techniques to minimize PAR to help reduce equipment costs and achieve more efficient operations; and
- Permit measurement of handset EIRP based on average power as well, to ensure consistent measurement methods.

These rule changes will promote important policy goals and ensure that the Commission's rules are applied in a technologically-neutral manner. In the future, the Commission should continue to update its rules to keep pace with technological changes so that industry can bring the full advantages of new technology to wireless consumers.

Respectfully submitted this 19th day of December, 2005.

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